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ABSTRACT

This study explores the speculation that unidentified factors such as organizational complexity might account for disparate research findings regarding the relationship between the administrative component and organization size. Complexity and size of organization were found to be significantly related variables, although there is no evidence to support the notion that the administrative ratio is linearly related to either of the two organizational variables. Four areas of speculation are considered: irrationality in organization, "administrative style," wealth of the system, and Blau's "Formal Theory of Differentiation in Organizations." However, the determination of the exact form of the relationship among the three variables of administrative component size, complexity, and size of organization is still unexplained. It seems logical, however, that the next step in the accumulation of empirical knowledge would concern this growth relationship. (Author)

Organizational Complexity: the Relationship Between the Size of the Administrative Component and School System Size

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I

GROWTH IN ORGANIZATIONAL AND ADMINISTRATIVE COMPONENT SIZE

According to Blau and Scott (1962), there is a popular notion that ". . .large organizations tend to be overbureaucratized; that is, an increase in organizational size is accompanied by a disproportionate increase in the administrative overhead." But the authors also stated "the evidence does not support this assumption." A review of literature by Haas, Hall, and Johnson (1963) demonstrated the lack of conclusive evidence about the relationship between the organization size and the size of the administrative component.

> "The findings from a number of studies support the proposition that the relative size of the supportive component increases as the total organization increases in size. Reviewing the relevant findings for industrial firms, Dubin (1958) concludes that 'bigger companies need proportionally more people to manage and administer their affairs.' Melman (1954), in a historical analysis of industrial firms in the United States and the United Kingdom, found that an increasing proportion of the personnel are concerned exclusively with management and administion. This increase has accompanied the well-known growth in overall size of business organizations. Bendix (1956) found a similar historical trend in France, Germany and Sweden. The Melman-Bendix data both represent national totals, however, and do not treat varying organizational size directly.
>
> In a study of public school systems, Terrien and Mills (1955) presented evidence supporting the proposition that the size of the supportive component does increase at a greater rate than total organizational size. Baker and Davis (1954) supply partial corroboration for this thesis in a study of Ohio manufacturing firms. Certain "staffs" or supportive activities did show larger increases in size than did other activity areas as the organizations increased in total size. Wilensky (1956), in his study of staff experts in labor unions, suggests that greater use is made of such experts in unions which engage in multiplant, company-wide, industry-wide, national or regional contracts. These unions are typically larger than the one-company local union. These writers all suggest that the supportive component will be proportionally larger in size in larger organizations than in smaller organizations.
>
> Opposite conclusions were drawn by Anderson and Warkov (1961) in their study of veterans hospitals. They found that the relative size of the supportive component decreases as total organizational size increases. Bendix came to the same conclusion in his study of German industrial firms. Baker and Davis, who pointed out that certain staff activities did increase disproportionately in size, also found that other activities of the staff either did not increase at the same rate as organizational growth, or increased in size in a linear fashion with neither a disproportionate increase nor decrease.
>
> These findings, despite their evident incompatibilities, represent the major body of evidence in regard to the supportive component's relative size."

The review is appropriate for the period up to 1964. Since then, two additional studies supplement the literature. Research in U. S. Army hospitals and in Canadian public schools supports the existence of an inverse relationship between the administrative ratio and organizational size. But these additional studies do not alleviate the ambiguity regarding research findings.

Studies supporting the proposition that the relative size of the supportive component increases as the total organization increases in size, and other studies supporting the proposition that the size of the supportive component decreases as total organizational size increases, prompt a question about the extent to which the type of organization involved might explain the disparate findings. This question can be partly answered if findings are in agreement when data about only one type of organization are examined. Thus this study involves one kind of organization, the public school system. Using the school system, then, two attempts were made to test the relationship of organizational size and administrative component.

Terrien and Mills (1955) found ". . . .the school administrator may expect that the percentage of his organization which is devoted to administrative tasks may rise as his organization grows." Although Gill and Friesen (1968) "replicated in part" the Terrien and Mills study, the general findings were different. Gill and Friesen concluded, "As school systems increase in size, the proportion of staff in the administrative component declines."

As previously noted, the research findings across all types of organizations are in conflict; when one organizational type is singled out, the problem persists. This leads to another question. How can two studies of school systems produce conflicting results?

Three areas of investigation seemed appropriate to examine when attempting to account for the difference in the findings of the two school system studies. Time differential between the two studies might have made a difference. Location--California as opposed to Western Canada--might have been a cause of the disparate findings. However, neither time nor location seem sufficient to explain such divergent findings. Thus definitions of organizational size and/or administrative component were left to provide an explanation for the differences. In this regard, both studies utilized total number of employees to define organizational size. Regarding the assignment of staff to the administrative component, the following definitions for each study are presented.

Terrien and Mills:

> "The administrative component of the school district included the superintendent, his assistants, and immediate staff, principals, business managers, and the like. Persons in the non-administrative component were teachers, nurses, custodians, cafeteria workers, and the like. Students were not included."

Gill and Friesen:

> "The administrative staff for purposes of the study included (a) principals (b) personnel identified both as administrative and non-administrative staff, but employed or housed directly in the central office of the school system. It included pupil personnel workers for example. Clerical, custodial, and cafeteria work staffs, and staffs of such sections as stores, equipment or maintenance were excluded. The number of administrative staff was expressed as a percentage of the total size of the school system. This proportion is termed the administrative component."

In the Terrien and Mills study, the terms "administrative personnel" and "the like" were not made clear. Essentially the same thing may be said of the more recent study by Gill and Friesen. Their use of "personnel defined both as administrative and non-administrative staff, but employed or housed directly in the central office of the school system" was clarified somewhat beyond that of the companion study. However, the personnel of the component were not explicitly identified.

Both studies would be difficult, if not impossible, to replicate due to their definitional ambiguity and lack of specificity in the make-up of the administrative component. For example, Gill and Friesen explained that clerical

staff were not included in the administrative component, but Terrien and Mills did not say if clerical staff were in or out.

Acknowledging definitional ambiguity in the two studies, the question arose: might this result in disparate findings? Differences in definition only inflate or deflate the ratio of the administrative component to the total; in no way do these differences account for a finding of an inverse relationship between the two variables. It followed, then, that definition alone was insufficient to account for the disparate findings.

The obvious lack of agreement associated with research already conducted on the subject suggested a rationale for further studies. It suggested that unidentified factors in organizations influence the size of the administrative component; when these factors are identified, the different results can be explained. In this regard, one of the factors might be organizational complexity. According to Haas, Hall, and Johnson (1967), organizational complexity is "the degree of internal segmentation." Internal segmentation suggested the need for coordination; since it is a prime function of administration, it was expected that a direct relationship existed between organizational complexity and the size of the administrative component.

There was sufficient reason to assume that organizational complexity was related to organizational size. Caplow (1957) specified a complexity-size relationship when he said: "The relational complexity in small groups increases rapidly with small increases in size." Terrien (1959), to indicate that interaction among individuals results in increased complex relationships, used a sociological axiom: "The number of potential intragroup relationships increases at a greater rate than does the size of the group." Extended evidence of the complexity-size relationship was expressed in Bossard's conceptual "Law of Family Interaction" that suggests "the complexity of family relationships increases in greater proportion than the numerical number of family members." Anderson and Warkov (1961) utilized Durkheim's assertion, "the growing density of population in a society results in increasingly complex forms of organization," in conjunction with the observations of Simel and Spencer, "an increase in size necessitates more complex forms of communication," to establish the importance of the concept of organizational complexity to the size relationship.

There was sufficient reason to assume that organizational complexity is related to organizational factors other than size. It seemed reasonable to assume that organizations with multiple goals are more complex than those having single goals. Organizations with widely dispersed physical facilities should be more complex than those having compact or single facilities. Anderson and Warkov noted that "the function of coordination is alleged to become relatively more difficult with an increased number of personnel and with a greater variety of role activities and tasks." The variety of tasks in some organizations certainly vary from those in other organizations. As such, some could be said to be more complex than the others. Organizations having relatively little personnel turnover, thus greater stability, should be less complex than organizations with a high personnel turnover. The way decision-makers structure developing organizations implies that human weakness can result in the creation of organizational complexity. Organizations having interaction and interdependent relationships with other agencies within the environment should be more complex than those without such relationships.

The evidence, while neither overwhelming or conclusive, warranted the inclusion of complexity as an explanatory variable in the size relationship. According to Anderson and Warkov, complexity might be more important than the size of the organization in determining the administrative component size. Blau and Scott made a case for the importance of the complexity variable in their analysis of Terrien and Mills' study.

> "Larger school systems were probably more complex than smaller ones--administering several schools in different locations rather than one single one--and this complexity, not size itself, may have been responsible for their larger administrative staffs."

The central problem for study was an examination of ratio relationship between organizational size and the administrative component when organizational complexity is controlled. A fundamental question guided the research: How important is organizational

complexity to the relationship between the other two major variables? Evidence of this influence was obtained when the following questions were raised:

1. Is there a significant relationship between organizational size and the ratio of the administrative component to organizational size when organizational complexity is held constant?

2. Is there a significant relationship between size of organization and organizational complexity when the size of the administrative component ratio to organizational size is held constant?

3. Is there a significant relationship between organizational complexity and the size of the ratio of the administrative component to organizational size when size of the organization is held constant?

II

ORGANIZATIONAL SIZE, ADMINISTRATIVE COMPONENT AND COMPLEXITY

Organizational size usually is defined in terms of the organization's membership or the number of persons employed. Although this does not preclude such other measures of size as the use of gross product, either produced or its capacity for production, or the utilization of physical and institutional arrangements, membership and/or employment seem to have a commonality that crosses organizational boundaries.

A survey of the literature indicates that there is a lack of a clearcut definitional taxonomy for the size variable. However, the greatest amount of agreement is achieved when the various definitions are examined using total organizational membership and/or employment as a common denominator. This is particularly true for school systems. Thus based on what agreement there is for the organizational-size variable, and to compare findings from other school-system studies with this one, the following two definitions of organization size were utilized:

1. Total number of personnel employed in the system
2. Pupil membership of the school system.

Both definitions are such that their measurement can be accomplished by the use of a simple count. The total number of employees for each school system was obtained by counting the number of adults it employed full-time. Part-time and volunteer employees were translated to full-time equivalents by taking the number of hours they worked and dividing it by the number of hours worked by the full-time person in that position.

Pupil membership commonly is used by school personnel and school related agencies as an index of school system size. Official reports, on which school systems depend for their share of the allocation of financial resources from governmental agencies, generally express school district size in terms of its pupil population. For measurement purposes in this study, pupil population was obtained by a simple count. However, this index of size, expressed as average daily membership (ADM), reflects the number of pupils belonging for a specified period of time.

The administrative component of organizations has been defined several ways. Those using the term as a variable in organizational study have utilized definitions that range from one that incorporates development of an underlying conceptual structure to one that uses some judgmental specification of the component's personnel membership. This continuum of definitions collects on one end those definitions concerned with the performance of functional tasks by members of the administrative component, e.g., coordination, decision making, and planning. On the other end are gathered definitions based on the titles that exist within the administrative component, and the identification, in some fashion, of the persons who perform the tasks affiliated with the titles. As a polar position is obtained, judgmental assignment of the performers to tasks appears to complete the spectrum.

A comparative examination of research studies utilizing a definition for the

administrative component revealed considerable divergence and ambiguity, especially when viewed across a variety of organizational types. The lack of definitional agreement, then, provided the impetus to establish multiple definitions for the administrative component.

Three such definitions were constructed in terms of specific titles found to be consistent with the glossary of titles for the entire state containing the sample of school systems (Oregon School Directory, 1969). The definitions were carefully constructed to reflect a range that included one with a narrow interpretation of the administrative component to one extremely broad. Number one was constructed to consist of titles for top administrators only, thus becoming the most restrictive or basic definition. Number two incorporated definition one and was extended by the addition of school building administrators. Definition three represented the broadest interpretation of the make-up of the administrative component. It consisted of the basic definition number one, minus number two, but added all non-clerical central-office personnel to the group. Of some concern was the recurring definitional issue of whether clerical personnel should be included in the component. Since the basic definition was included in the other two, a decision was made to use the remaining two definitions to see what effect may be attributed to the absence or presence of clerical personnel in the make-up of the administrative component. This, in effect, caused the original three definitions to be expanded to five. Therefore, the following five definitions for the administrative component were used in the study:

I. Top Administrators:
(Titles included)

Superintendents
Deputy Superintendents
Assistant Superintendents
Administrative Assistants
Directors

II. Top Administrators plus Building Administrators:
Clerical Out
(Titles included)

Superintendents
Deputy Superintendents
Assistant Superintendents
Administrative Assistants
Directors
Principals
Assistant Principals
Project Leaders

III. Top Administrators plus Building Administrators:
Central Office Clerical In
(Titles included)

Superintendents
Deputy Superintendents
Assistant Superintendents
Administrative Assistants
Directors
Principals
Assistant Principals
Project Leaders
Secretaries - Central Office
Clerks - Central Office
School Board Clerks

IV. Top Administrators plus Central Office Staff:
Clerical Out
(Titles included)

Superintendents
Deputy Superintendents
Assistant Superintendents
Administrative Assistants
Directors
Supervisors
Managers
Coordinators
Consultants
Social Workers
Psychologists
Speech and Hearing Therapists
Instructional Media Specialists
Home Instruction Teachers
Attendance Officers
Purchasing Agents

V. Top Administrators plus Central Office Staff
Central Office Clerical In
(Titles included)

Superintendents
Deputy Superintendents
Assistant Superintents
Administrative Assistants
Directors
Supervisors
Managers
Coordinators

Consultants
Social Workers
Psychologists
Speech and Hearing Therapists
Instructional Media Specialists
Home Instruction Teachers
Attendance Officers
Purchasing Agents
Data Processing Personnel
Secretaries - Central Office
Clerks - Central Office
School Board Clerks
Bookkeepers
Project Leaders
Accountants
Maintenance Personnel
Custodial Personnel
Transportation Personnel
Messengers
Interns

While the make-up of the administrative component was of major importance, its membership specification for determining the size relationship to organizational size was only meaningful when expressed in ratio form. Therefore, administrative ratio for this study was defined as the ratio of the size of the administrative component to the size of the school system. It was computed by dividing the number representing the administrative component by the number representing the size of the school system.

The utilization of five definitions of the administrative component required a total of ten administrative ratios, five for each measure of school system size. These administrative ratios, when computed, became the operational measure for the administrative component variable.

Complexity as a variable in organizational study has been described in several ways. W.W. Charters, Jr., in a recent paper (1970), traced the concept of complexity as it has been employed in empirical investigations over the last decade. Excerpts from his analysis are presented for their relevance to the selection of both the complexity definition and its measurement as utilized in this study.

Charters, in surveying the literature, notes that the earliest attempt to give operational meaning to complexity utilized supervisory attention as an intervening variable linking complexity to the dependent variable of authority levels (Udy, 1959). Subsequent research, Charters found, had as an intervening variable the broader concept of coordination (Anderson and Warkov, 1961). From this position, complexity came to refer specifically to the division of labor (Rushing, 1967). Other writers considered functional complexity to mean degree of occupational specialization (Hage, 1965, Hage and Aiken, 1967a, 1967b; Aiken and Hage, 1968).

More recently, a global approach to the subject was proposed. According to Charters:

> "Hall and his colleagues used complexity to cover substantially more territory (Hall, Haas, and Johnson, 1967a, 1967b). 'Complexity . . . is the degree of internal segmentation--the number of separate 'parts' of the organization as reflected by the division of labor, number of hierarchical levels, and the spatial dispersion of the organization' (1967b, p. 906). Thus, complexity is an attribute of the total organization, a dimension along which organization 'configuration' varies (Pugh and others, 1963); it mixes what Rushing called 'structured differentiation' and 'individual differentiation,' i.e., division of labor (Rushing, 1967); and it includes as one of its components the 'geographical location' variable of Anderson and Warkov (1961). Complexity is, indeed, an omnibus term for Hall, Haas, and Johnson . . ."

Haas, Hall, and Johnson, as Charters states "used complexity to cover more territory" than did their predecessors. Because the three researchers' complexity definition seemed applicable for use in the study of school systems, the definition was adopted for use in this study. Complexity, then, "is the degree of internal segmentation--the number of separate 'parts' of the organization as reflected by the division of labor, number of hierarchical levels, and the spatial dispersion of the organization."

Haas, Hall, and Johnson used eleven indicators of complexity for

organizational analysis. These indicators were modified with specific interpretations to improve the understanding of what was being measured in the school systems.

The complexity indicators or operational definition utilized in this study was a straightforward adoption of the one used in the research of Hass, et al. A basis for the use of these indicators of complexity resulted from their apparent ability to incorporate the dimensions suggested in the literature; e.g., supervisory attention, coordination, division of labor and occupational specialization.

Major modification of the scheme developed by Hass, et al., exists to the extent that the authors' eleven complexity indicators were reduced to nine. In addition, minor modification may have resulted from interpolations made to accommodate the organizational type of school systems.

The operational definition (indicators of complexity), together with interpolation and measurement specifications as utilized in this study, follows.

A. Division of Labor -- General

1. Presence of more than one major organizational activity

In school systems this is best represented by schools operating specialized programs for students outside the scope of general education. Examples would be school and/or programs of special education for the visually, mentally, physically, or emotionally handicapped; vocational; adult education; and any of the federally supported compensatory programs for disadvantaged youth. Since kindergarten programs do not fall within compulsory attendance laws in the state where the sample was drawn, they also should serve as an indicator of internal segmentation.

Measurement: A simple frequency count of the number of specialized programs operated by each school district was obtained and summed to provide a total complexity score for part A. Since all school systems operate a general education program regardless of their size, no district would receive a total complexity score of less than one.

B. Division of Labor -- Specific

1. The number of major divisions or departments (horizontal differentiation)

Organization charts for school systems usually depict functionally different divisions or departments. For example, one may expect a separation between the function of business and the function of instruction even though they share a logical interdependency. In addition, school systems commonly have divisions or departments for personnel services and general administration. Less frequent are the following: special or pupil services, school plant planning, community or public relations, data processing, and research and development.

Measurement: A simple frequency count of functionally different divisions was obtained for each school system in the sample. This score represented one-third of the system's total complexity score for part B of the operational definition.

2. The most specialized department (number of district subdivisions under major departmental headings)

One might expect the best example of this to be a school system's instruction division or department. For instance, using position titles as an index of office, this unit may be composed of the following subunits: assistant superintendent, executive and/or directors of elementary and secondary schools, coordinators, consultants, supervisors, program or project leaders, principals, and assistant principals.

Measurement: A frequency count of the number of subunits within the most specialized division was taken and tallied as a score for each school system. This score also represented one-third of the system's total

complexity score for part B.

3. Mean intradepartmental subdivision (the total number of subdivisions divided by the number of departments)

Measurement: A mean score for each school system was derived by taking a frequency count of the number of distinct subdivisions (section 1 of part B) and dividing this number by the number representing a frequency count of the organization's total number of departments. This score represented the final one-third of each district's complexity score for part B. The additive nature of these three indicators will be discussed under the topic of "total school system complexity score."

C. Hierarchical Differentiation

1. Number of levels in the deepest single division

This seems clear when the example of the instructional division is utilized. Who reports to who should be reasonably well established in school systems.

Measurement: In the course of data-collection interviews with sample school system representatives, they were asked to identify their deepest single division and either furnish or diagram a current organizational chart from which a count could be taken. The number obtained represented one-half of the complexity score for part C for the school system.

2. The mean number of hierarchical levels for the organization as a whole (the sum of the number of hierarchical levels within every department divided by the number of departments)

Measurement: Using a diagram of each organization, a count was made of the total number of hierarchical levels for the organization as a whole. A mean score was obtained for each school system by dividing that number by the sum of the count of the number of departments within the organization. This score represented the other one-half of the complexity score for part C. The additive nature of these two indicators will be discussed in the topic of "total school system complexity score."

D. Spatial Dispersion

1. The degree to which physical facilities are spatially dispersed

The term degree in this study means the number of separate locations. Headquarters are where the greatest number of administrative personnel are housed.

Measurement: A count was made of the number of independent facilities of the school system. The number obtained represented one-third of the district's complexity score for part D.

2. The location (distance from the organizational headquarters of spatially dispersed facilities)

Measurement: Actual distance, in miles and tenths of miles, was recorded from the district headquarters to each separate facility operated by the system. Headquarters, when located in the only facility operated by a school system, received a distance score of 0. Where a distance measure was obtained between the headquarters and one or more separate facilities, the sum of that distance represented one-third of the complexity score for part D.

3. The degree to which personnel are spatially dispersed

The term degree, as indicated above, means number for the purpose of this study. In this case, it means the number of personnel physically removed from the headquarters of the school district.

Measurement: A count of personnel located away from headquarters was made and converted to a percentage figure. This percentage figure then constituted the remaining one-third of the district's complexity score for part D.

It was noted in the context

of the operational definition (parts A, B, C, and D), that the separate complexity indicators represented only a portion of the total score for each of these major divisions. The problem of making the indicators or scales additive was readily apparent. There was a need to arrive at total scores for each of the four major parts and ultimately obtain a composite complexity score for each school system in the sample. In addition, the other two major variables of the study, system size and administrative ratio, had data that could be measured intervally. To examine the effect of complexity on the relationship between the other two variables required an examination of the complexity indicators to determine if the data were interval. The indicators contained the properties of equal distance and could be ordered. Therefore, they satisfied the requirements for interval scaling. However, the scales were unlike; therefore they required conversion to a standard form. The numerical numbers obtained from frequency counts were converted to standard (T) scores in the manner described by Guilford (1965). Once obtained, the T-scores became additive and provided the method for determing a composite complexity score for each school system in the sample.

The four major divisions were composed of unequal numbers of scales. One method of reducing the inequality among the four major parts of the total complexity measure was to take the mean of scale T-scores in each part before summing for a total complexity score. This was done and intercorrelations run among the four divisions as well as the parts with the composite complexity score.

study design and research procedures

This study is a "descriptive, causal-comparative" one having an ex post facto, after-only design. It is a search for the effect of complexity on the size relationship between school systems and their administrative components.

In determining the population to be studied, Terrien and Mills' lead was followed. They selected a single state, California, in which to conduct their research. Using the same rationale, that school systems would be ". . .performing the same general function and circumscribed by much the same legislation and directives," the State of Oregon was selected to represent the broad parameters for study. The state contains 356 public school systems (Oregon School Directory, 1969) divided into elementary, union high, unified, and county unit districts. Only the first three types were considered for use in the study since there were only four county unit districts. The sample was drawn from public school systems located within six contiguous counties that constitute Oregon's Lower Willamette Valley.

The sample was drawn from public school systems located within the six counties previously identified. There are 148 school systems within this area with size (arbitrary division) distribution (ADM) as follows:

ADM		Number of School Systems
Very Small	0 -- 100	36
Small	101 -- 500	53
Medium	501 -- 2,000	36
Large	2,001 -- 74,707	23

Inasmuch as school systems having 100 or fewer pupils are on the decline due to the process of consolidation, 36 districts were dropped from the sample. Fifteen school systems were drawn randomly from the remaining three ADM categories yielding a total of forty-five districts that comprised the sample. It was thought that forty-five school systems (40 per cent of 112 school systems) would provide a large enough sample to statistically test the hypotheses. And the number was small enough to enable one researcher to make on-site data collection.

data collection

The nature of the data required for measurement of the three variables was such--e.g., items requiring access to documents and records pertaining to personnel, organization arrangements, number and distance among and between facilities--that it seemed appropriate to have the investigator make an on-site data collection. Each school system superintendent was contacted by telephone; the nature of the study was explained, and with his approval, a time was established for the visitation. When they personnally were unable to offer their

assistance, an appropriate member of their staff was available.

hypotheses

The data were collected for the purpose of answering the guiding questions introduced in chapter I. These guiding questions were translated into operational hypotheses for the purpose of testing. They are as follows:

Hypothesis I

If organizational complexity is controlled, then the correlation between the ratio of the administrative component to organizational size and the size of the containing organization will not differ significantly from zero.

Hypothesis II

If the ratio of the administrative component to organizational size is controlled, then the correlation between organizational size and organizational complexity will not differ significantly from zero.

Hypothesis III

If organizational size is controlled, then the correlation between organizational complexity and the ratio of the administrative component to organizational size will not differ significantly from zero.

treatment of data

Administrative components and school system sizes were computed for each system in the sample. From these data, ten administrative ratios were derived utilizing the five definitions of administrative component and the two indexes of system size.

The sample was divided into subgroups according to size of organization by using both indexes, pupil (ADM) and total personnel. Means and standard deviations of administrative ratios for the size groupings of small, medium, and large school systems were then computed.

Correlations among the three variables, letting administrative ratio represent the administrative component, were computed and tested for significance.

Multiple linear regression models were constructed using selected measures of the two independent variables and the different definitions of the administrative ratio as the dependent variable.

III

COMPARISON OF FINDINGS WITH OTHER SCHOOL-SYSTEM STUDIES

This chapter compares findings from this study--having a three-variable design of complexity, organizational size, and administrative component size--with findings from other school-system studies having only a two-variable design of organizational size and administrative component size. Prior to conducting such a comparison, however, it was necessary to examine each of the variables independent of each other. The latter two are discussed in this chapter. The third, organizational complexity, is examined in chapter IV. The variable examination is used to see what the data look like across the total sample of forty-five school systems.

organizational size

One measure of size was utilized in the study: total number of employees.

Table I shows the number of school systems in the sample by type (elementary, union high, and unified) and the number of pupils (ADM) and the total number of employees (employee size).

The total sample of forty-five school systems ranged in size (two measures) from 121.7 to 22,257 pupils (ADM) and had a range of 8.4 to 1776.57 employees.

If the sample is separated into school-system types, it includes: (a) twenty-one elementary school systems with a pupil (ADM) range of 121.7 to 4,946.2 and an employee range of 8.4 to 361.1; (b) six union high school systems having a pupil (ADM) range of 367.8 to 3,664.9 and an employee range of 29.6 to 319; and (c) eighteen unified school systems with a pupil (ADM) range of 279.8 to 22,257.0 and an employee range of 36.88 to 1776.57.

administrative component

Table II shows the raw-data distribution of the number of personnel for each of the five definitions in the administrative component.

Inspection of the displayed data shows that the overall sample range of the size of the administrative component is 0 to 104. The range for each of the five definitions of administrative component in the sample is shown in figure 1.

It appears from these data that definitions I and IV are the most restrictive, closely followed by definition II. Furthermore, the addition of central-office clerical staff makes a significant difference in the size of the administrative componen when comparing definitions III and V with definitions II and IV. In definition V, the administrative component size is triple the size of the component in definition IV. In definition III, the number of personnel in the administrative component is almost double that in definition II.

When system type is examined, the ranges for the number of personnel by definition are shown in figure 1.

TABLE I

SCHOOL SYSTEM TYPE AND SIZE BY PUPIL (ADM)
AND TOTAL NUMBER OF EMPLOYEES

System Identification Number	System Type	System Size Pupil (ADM)	System Size Total Employees	System Identification Number	System Type	System Size Pupil (ADM)	System Size Total Employees
1.	Elementary	121.70	8.40	24.	Elementary	1170.50	101.50
2.	Elementary	136.90	13.30	25.	Unified	1360.30	93.80
3.	Elementary	224.70	18.00	26.	Elementary	1552.60	142.00
4.	Unified	279.80	36.88	27.	Union High	1607.00	125.00
5.	Elementary	300.50	26.90	28.	Unified	1806.20	150.00
6.	Elementary	305.60	23.80	29.	Elementary	1974.00	122.33
7.	Elementary	309.90	26.90	30.	Unified	2022.70	474.10
8.	Elementary	324.40	24.30	31.	Elementary	2245.90	168.30
9.	Elementary	365.90	31.75	32.	Elementary	2559.80	192.92
10.	Union High	367.80	29.60	33.	Unified	2858.70	253.45
11.	Union High	376.00	33.42	34.	Unified	3008.70	254.40
12.	Elementary	393.00	27.80	35.	Unified	3092.80	248.73
13.	Elementary	416.00	31.00	36.	Unified	3565.90	292.50
14.	Elementary	491.80	33.80	37.	Union High	3637.40	319.00
15.	Unified	546.70	50.00	38.	Union High	3664.90	263.00
16.	Elementary	600.10	49.50	39.	Unified	4822.90	385.10
17.	Elementary	709.20	70.50	40.	Unified	4835.40	372.40
18.	Unified	806.60	62.20	41.	Elementary	4946.20	361.10
19.	Unified	879.20	64.80	42.	Unified	5667.70	451.50
20.	Unified	945.70	67.75	43.	Unified	9770.50	895.15
21.	Unified	1051.30	81.20	44.	Unified	18235.30	1426.00
22.	Elementary	1101.40	90.00	45.	Unified	22257.00	1776.57
23.	Union High	1153.80	93.75				

NOTE: In Tables I - III, school systems are ordered according to increasing pupil size (ADM)

Ranges for the administrative component using system type were similar to those obtained for the size of system variable. Elementary and union high systems had fewer personnel making up the administrative component than did unified systems. Since unified systems possess the characteristics of both the elementary and union high systems, this finding did not seem unusual.

As noted in chapter II, the membership of the administrative component is meaningful only when expressed in ratio form. Administrative ratio was defined as the ratio of the size of the administrative component to the size of the school system. The ratios were computed by dividing the number representing the administrative component by the number representing the size of the school system.

Table III shows the computed ratios for the measure of system size and total employee size. The utilization of five definitions of the administrative component required a total of five administrative ratios for each school system in the sample. These administrative

TABLE II

SCHOOL SYSTEM TYPE AND NUMBER OF EMPLOYEES IN THE ADMINISTRATIVE COMPONENT BY DEFINITION

System Identification Number	System Type	Admin. Component Defin. I - No. of Top Admins.	Admin. Component Defin. II - No. of Top Admins. Plus Building Admins. (Clerical Out)	Admin. Component Defin. III - No. of Top Admins. Plus Building Admins. (Cent. Office Cler. In)	Admin. Component Defin. IV - No. of Top Admins. Plus Cent. Office Staff (Clerical Out)	Admin. Component Defin. V - No. of Top Admins. Plus Cent. Office Staff (Cent. Office Clerical In)
1.	Elementary	0.0	0.50	0.80	0.0	0.30
2.	Elementary	0.0	1.00	1.50	0.0	0.50
3.	Elementary	0.25	0.75	1.75	0.50	1.50
4.	Unified	0.70	2.45	4.45	0.70	2.70
5.	Elementary	1.00	1.00	2.30	1.00	2.30
6.	Elementary	0.50	1.00	1.50	0.50	1.00
7.	Elementary	0.50	1.00	2.10	0.50	1.60
8.	Elementary	0.50	1.00	1.50	0.50	1.00
9.	Elementary	0.25	0.75	1.75	0.25	1.25
10.	Union High	0.50	1.50	2.50	0.60	1.50
11.	Union High	0.67	2.00	3.50	0.67	2.17
12.	Elementary	0.50	1.50	2.50	0.50	1.50
13.	Elementary	0.0	1.50	2.00	0.0	0.50
14.	Elementary	0.0	1.00	1.80	0.0	0.80
15.	Unified	1.00	3.00	4.50	1.00	2.50
16.	Elementary	1.00	2.00	3.00	1.00	2.00
17.	Elementary	0.50	3.00	4.50	0.50	2.00
18.	Unified	0.50	3.20	4.20	0.50	1.50
19.	Unified	0.50	3.00	4.00	0.50	2.50
20.	Elementary	1.00	1.00	2.00	1.00	2.00
21.	Unified	1.00	4.00	6.00	1.00	3.00
22.	Elementary	2.50	4.00	6.00	2.50	4.50
23.	Union High	0.50	2.50	3.50	0.50	1.50
24.	Elementary	1.00	3.00	5.00	1.00	3.00
25.	Unified	1.00	4.00	5.00	1.00	2.00
26.	Elementary	4.50	10.50	13.00	6.50	11.00
27.	Union High	1.50	4.50	6.00	1.50	3.50
28.	Unified	2.00	6.00	9.00	2.00	5.00
29.	Elementary	1.00	4.00	6.00	1.00	5.00
30.	Unified	6.00	20.00	29.00	14.50	35.00
31.	Elementary	3.00	9.00	14.10	7.00	18.60
32.	Elementary	4.00	10.00	14.00	6.00	14.00
33.	Unified	6.00	16.00	20.00	7.30	12.30
34.	Unified	1.00	9.00	13.00	4.00	9.50
35.	Unified	2.00	11.30	16.30	2.00	8.00
36.	Unified	2.00	11.00	16.00	3.00	10.00
37.	Union High	2.00	10.00	12.00	3.00	7.00
38.	Union High	3.00	12.00	16.00	4.00	9.00
39.	Unified	5.00	16.00	20.50	7.00	15.10
40.	Unified	3.00	18.00	22.00	3.60	9.60
41.	Elementary	4.00	20.00	25.50	6.50	15.20
42.	Unified	5.00	20.00	29.00	8.00	20.00
43.	Unified	6.00	28.00	58.50	17.50	53.00
44.	Unified	14.00	63.00	80.00	23.00	42.50
45.	Unified	7.00	54.00	104.00	19.00	80.00

TABLE III

RATIOS OF SIZE OF ADMINISTRATIVE COMPONENT TO EMPLOYEE SIZE ACCORDING TO ADMINISTRATIVE COMPONENT DEFINITIONS

System Identification Number	System Type	Definition I Ratio of Admin. Comp. to Employee Size	Definition II Ratio of Admin. Comp. to Employee Size	Definition III Ratio of Admin. Comp. to Employee Size	Definition IV Ratio of Admin. Comp. to Employee Size	Definition V Ratio of Admin. Comp. to Employee Size
1.	Elementary	.0000	.0595	.0952	.0000	.0357
2.	Elementary	.0000	.0752	.1128	.0000	.0376
3.	Elementary	.0139	.0417	.0972	.0278	.0833
4.	Elementary	.0190	.0664	.1207	.0190	.0732
5.	Elementary	.0372	.0372	.0855	.0372	.0855
6.	Elementary	.0210	.0420	.0630	.0210	.0420
7.	Elementary	.0186	.0372	.0781	.0186	.0595
8.	Elementary	.0206	.0412	.0617	.0206	.0412
9.	Elementary	.0079	.0236	.0551	.0079	.0394
10.	Union High	.0169	.0507	.0845	.0169	.0507
11.	Union High	.0200	.0598	.1047	.0200	.0649
12.	Elementary	.0180	.0540	.0899	.0180	.0540
13.	Elementary	.0000	.0484	.0645	.0000	.0161
14.	Elementary	.0000	.0296	.0533	.0000	.0237
15.	Unified	.0200	.0600	.0900	.0200	.0500
16.	Elementary	0202	.0404	.0606	.0202	.0404
17.	Elementary	`71	.0426	.0638	.0071	.0284
18.	Unified	.. 80	.0514	.0675	.0080	.0241
19.	Unified	.0077	.0463	.0617	.0077	.0386
20.	Elementary	.0148	.0148	.0295	.0148	.0295
21.	Unified	.0123	.0493	.0739	.0123	.0369
22.	Elementary	.0278	.0444	.0667	.0278	.0500
23.	Union High	.0053	.0267	.0373	.0053	.0160
24.	Elementary	.0099	.0296	.0493	.0099	.0296
25.	Unified	.0107	.0426	.0533	.0107	.0213
26.	Elementary	.0317	.0739	.0915	.0458	.0775
27.	Union High	.0120	.0360	.0480	.0120	.0280
28.	Unified	.0133	.0400	.0600	.0133	.0333
29.	Elementary	.0082	.0327	.0490	.0082	.0409
30.	Unified	.0127	.0422	.0612	.0306	.0738
31.	Elementary	.0178	.0535	.0838	.0416	.1105
32.	Elementary	.0207	.0518	.0726	.0311	.0726
33.	Unified	.0237	.0631	.0789	.0288	.0485
34.	Unified	.0039	.0354	.0511	.0157	.0373
35.	Unified	.0080	.0454	.0655	.0080	.0322
36.	Unified	.0068	.0376	.0547	.0103	.0342
37.	Union High	.0063	.0313	.0376	.0094	.0219
38.	Union High	.0114	.0456	.0608	.0152	.0342
39.	Unified	.0130	.0415	.0532	.0182	.0392
40.	Unified	.0081	.0483	.0591	.0097	.0258
41.	Elementary	.0111	.0554	.0706	.0180	.0421
42.	Unified	.0111	.0443	.0642	.0177	.0443
43.	Unified	.0067	.0313	.0654	.0195	.0592
44.	Unified	.0098	.0442	.0561	.0161	.0298
45.	Unified	.0039	.0304	.0585	.0107	.0450

Definitions	Elementary	High School	Unified
Administrative Component Definition I - Number of Top Administrators	0 - 4.5	.5 - 3	.5 - 14
Administrative Component Definition II - Number of Top Administrators Plus Building Administrators (Clerical Out)	.5 - 20	1.5 - 12	2.45 - 63
Administrative Component Definition III - Number of Top Administrators Plus Building Administrators (Central Office Clerical In)	.8 - 25.5	2.5 - 16	4 - 104
Administrative Component Definition IV - Number of Top Administrators Plus Central Office Staff (Clerical Out)	0 - 7	.5 - 4	.5 - 23
Administrative Component Definition V - Number of Top Administrators Plus Central Office Staff (Central Office Clerical In)	.3 - 18.6	1.5 - 9	1.5 - 80

PERSONNEL RANGES FOR THE ADMINISTRATIVE COMPONENT
Figure 1

ratios became the operational definition (index), representing the size of the administrative component in the tests of the hypotheses, used in the study.

IV

RELATIONSHIP AMONG ADMINISTRATIVE COMPONENT, SIZE OF ORGANIZATION, AND COMPLEXITY

In chapters I and II discussion centered on the disparate research findings about the relationship between the variables of school-system size and the size of the administrative component.

Particular emphasis was placed on the selection of one type of organization --a school system--in an attempt to account for the disparate findings. However, failure to reconcile the disparate research findings after inspection of the literature resulted in speculation that something other than the size of the system could account for the size of the administrative component. In chapter III data obtained for this study were examined to find their independent and comparative contribution to the understanding of the two-variable relationship. Again, the findings did not alleviate the disparate research results.

Originally it was hypothesized that organizational complexity might account for these differences. This chapter, then, is devoted to the testing of the hypotheses relating to organizational complexity. Essentially, the hypotheses were formulated to permit an examination of the relationship among the organizational variables: administrative component, size, and complexity. First, however, it was necessary to examine the complexity variable as it appeared for the total sample of forty-five Oregon school systems.

complexity

Table IV displays complexity scores (T-scores) obtained for each system in the sample. Scores shown are for each of the four separate measures and their sums. The latter represent the total complexity score for each system in the sample.

The use of standard scores (T-scores) for the complexity measures was discussed in chapter II. Part of that discussion related to the question of the contribution the four parts make to the total complexity score for each system in the sample.

Two methods of assessing the contribution seem appropriate. The first is by inspecting table IV to determine the amount of spread within each of the four measures and subsequently the total complexity measure. In this regard:

- Part I (Division of Labor - General) had the widest range, from 39.56 to 75.49, a spread of 35.93 standard scores.
- Part II (Division of Labor - Specific) had a range from 44.63 to 70.96, a spread of 26.33 standard scores.
- Part III (Hierarchical Differentiation) had the second-widest range, 41.43 to 71.86, a spread of 30.43 standard scores.
- Part IV (Spatial Dispersion) had the least amount of spread, 20.52 standard scores as derived from the range of 46.81 to 67.33.

TABLE IV

SCHOOL SYSTEM TYPE AND COMPLEXITY SCORES (T-Scores)

System Identification Number	System Type	Part I - Division of Labor - General	Part II - Division of Labor - Specific	Part III - Hierarchical Differentiation	Part IV - Spatial Dispersion	Total Complexity Score
1.	Elementary	39.56	44.87	41.43	50.67	176.53
2.	Elementary	39.56	44.87	41.43	46.81	172.67
3.	Elementary	32.36	47.88	46.62	54.49	181.35
4.	Unified	53.93	47.88	48.92	55.12	205.85
5.	Elementary	46.74	47.88	38.84	56.40	189.87
6.	Elementary	39.57	47.88	41.43	57.13	186.00
7.	Elementary	39.57	47.88	46.62	56.01	190.06
8.	Elementary	46.74	47.88	46.62	57.18	198.42
9.	Elementary	32.37	47.88	48.92	57.37	186.54
10.	Union High	46.74	47.88	46.62	59.82	201.06
11.	Union High	46.74	47.63	43.74	55.66	193.77
12.	Elementary	39.57	47.88	56.41	56.36	200.21
13.	Elementary	39.57	47.88	54.10	57.73	199.28
14.	Elementary	39.57	44.87	41.43	57.85	183.71
15.	Unified	39.57	55.63	46.05	53.78	195.02
16.	Elementary	39.57	47.88	54.10	57.49	199.03
17.	Elementary	46.74	46.66	43.74	52.78	189.92
18.	Unified	53.93	47.88	54.10	58.53	214.45
19.	Unified	46.74	47.88	54.10	57.90	206.63
20.	Elementary	46.74	44.87	46.62	57.93	196.16
21.	Unified	53.96	47.88	48.92	57.11	207.85
22.	Elementary	46.74	47.88	54.10	56.94	205.67
23.	Union High	46.74	50.69	46.33	58.91	202.67
24.	Elementary	46.74	47.88	54.10	58.39	207.12
25.	Unified	53.93	47.88	54.10	58.49	214.41
26.	Elementary	46.74	57.07	49.47	55.14	208.43
27.	Union High	53.93	57.07	49.47	59.29	219.77
28.	Unified	46.74	51.66	46.33	58.03	202.76
29.	Elementary	46.74	50.64	43.74	57.75	198.87
30.	Unified	61.12	63.11	63.33	56.73	244.30
31.	Elementary	39.56	57.37	48.64	52.25	197.82
32.	Elementary	53.93	55.83	47.81	55.96	213.52
33.	Unified	68.31	54.76	40.87	58.61	222.55
34.	Unified	53.93	47.88	54.10	58.93	214.85
35.	Unified	68.31	47.88	61.59	58.92	236.70
36.	Unified	61.12	56.75	53.54	58.35	229.76
37.	Union High	53.93	54.76	63.90	59.20	231.80
38.	Union High	53.93	50.69	56.13	58.67	219.42
39.	Unified	53.93	55.22	46.05	58.74	213.94
40.	Unified	61.12	62.81	65.64	58.34	247.91
41.	Elementary	46.74	58.54	60.48	59.35	225.11
42.	Unified	46.74	57.72	51.23	56.14	211.84
43.	Unified	46.74	63.69	53.25	53.35	217.04
44.	Unified	68.31	68.18	71.86	59.10	267.44
45.	Unified	75.49	70.96	63.33	67.33	277.11

When the four measures were added to obtain a total complexity score for each system in the sample, the range was from 172.67 to 277.11, or a spread of 104.44 standard scores.

The second method used to examine the contributions of the four parts to the total complexity measure was guided by obtaining Pearson product-moment correlations. This information is shown in table V. All of the four measures had high (significant beyond the .01 confidence level) correlations with each other and with the total. It would seem that if one is a measure of complexity, then they all are. The four parts measure the same thing. Thus the total complexity measure is representative of its parts; as such, it is useful as an index of complexity in the sample of school systems. The complexity-score range, by school-system type, is displayed in figure 2. Using only the total complexity score as the index, elementary systems had a range of 172.67 to 225.11, union high systems had a range of 193.77 to 231.8, and unified school systems had a range of 195.02 to 277.11. These data reveal that elementary districts are the least complex, union high systems slightly more complex, and unified systems the most complex of the three types of school systems.

TABLE V

COMPLEXITY MEASURE CORRELATION MATRIX

	Part I - Division of Labor - General	Part II - Division of Labor - Specific	Part III - Hierarchical Differentiation	Part IV - Spatial Dispersion	Total Complexity Measure
Part I - Division of Labor - General	1.0000	.9377*	.7802*	.9234*	.8448*
Part II - Division of Labor - Specific		1.0000	.9300*	.9396*	.9308*
Part III - Hierarchical Differentiation			1.0000	.8913*	.9633*
Part IV - Spatial Dispersion				1.0000	.9696*
Total Complexity Measure					1.0000

*Significant at .01 level and beyond

SYSTEM TYPE	COMPLEXITY SCORES
Elementary (N = 21)	172.67 to 225.11
Union High (N = 6)	193.77 to 231.8
Unified (N = 18)	195.02 to 277.11

COMPLEXITY SCORE RANGE BY SYSTEM TYPE
Figure 2

relationship of variables

Now that each variable has been viewed independently in chapters III and IV, it is necessary to examine their interrelationship. The procedure initially used to examine this interrelationship involved obtaining Pearson product-moment correlations of the raw data among the three major variables. Once obtained, these raw data correlations were tested for significance using the null hypothesis of zero correlation and a two-tailed T-test. The primary reason for looking at the interrelationship among the variables in this particular way was to determine the magnitude and direction of the raw data correlations.

The findings from the raw data correlations showed that for the overall sample, definitions of the administrative component were positively correlated with both the size and the complexity variables. All but two of the correlations were significant at or beyond the 0.01 level and the latter two were significant at the 0.05 level. Differences in the definition do not have any influence on the direction of the correlation.

Of special note is the fact that both original definitions of organizational size--total number of employees and pupil (ADM) --are highly correlated (.73) and significant at or beyond the 0.01 level of confidence. Based on this evidence, further analysis of the data utilized just one definition of organizational size. Total number of employees was selected as the preferable definition because of its comparable status in various kinds of organizations.

A second analysis also was conducted, again using Pearson product-moment correlations, for the three-variable relationship. In this instance, administrative ratios were used in place of the numerical definitions of the administrative component. The results are displayed in table VI. This second correlational analysis of the data using administrative ratios made considerable difference in the magnitude, the level of significance, and the direction of the correlations. That is, the correlations were smaller, not statistically significant, and tended to be in a negative direction.

Similar conclusions can be drawn for the relationship between administrative ratio and the complexity variable. Only one of the cells was statistically significant. It was in a negative direction as were three other cells. The one remaining cell, while positive, barely attained that position. Therefore, if a conclusion as to directional tendency can be made, it is that the correlations are in a negative direction.

tests of hypotheses

Prior to a presentation of the relevant data concerning the tests of the study's three hypotheses, the method of analysis used must be understood. The method is not unique; it is an extension of multiple regression analysis, a more popular method of data analysis. However, stepwise multiple regression has additional advantages. For example, Efroymson (1960) explains:

> "Multiple regression is used in data analysis to obtain the best fit of a set of observations of independent and dependent variables by an equation of the form:
>
> $$y = b_0 + b_1 x_1 + b_2 x_2 \ldots b_n x_n$$
>
> where y is the dependent variable; x_1 x_2 . . . are the independent variables; and b_0, b_1 . . . are the coefficients to be determined."

Stepwise multiple regression analysis obtains essentially the same results as regular multiple regression analysis except that the former adds a number of intermediate regression equations. According to Efroymson:

> "These equations are obtained by adding one variable at a time and thus give the

TABLE VI

ADMINISTRATIVE RATIOS, EMPLOYEE SIZE, AND COMPLEXITY CORRELATIONS

Administrative Ratios Computed With Employee Size	Employee Size	Pupil (ADM) Size	Complexity
I	-.2270	-.2297	-.1437
II	-.1871	-.1816	-.1228
III	-.2328	-.2358	-.3609*
IV	0.0148	-.0202	0.0364
V	-.0336	-.0725	-.1564

*P was significant at and beyond the 0.05 level using a two-tailed test.

following intermediate equations:

$$y = b_0 + b_1 x_1$$

$$y = b'_0 + b'_1 x_1 + b'_2 x_2$$

$$y = b''_0 + b''_1 x_1 + b''_2 x_2 + b''_3 x_3$$

The variable added is that one which makes the greatest improvement in 'goodness to fit.' The coefficients represent the best values when the equation is fitted by the specific variables included in the equation.

An important property of the stepwise procedure is based on the facts that (a) a variable may be indicated to be significant in any early stage and thus enter the equation, and (b) after several other variables are added to the regression equation, the initial variable may be indicated to be insignificant. The insignificant variable will be removed from the regression equation before adding an additional variable. Therefore, only significant variables are included in the final regression."

In testing the hypotheses for this study, then, stepwise regression analysis was used to control key independent variables when computing correlations. The computation of correlation coefficients (or linear regression equations) attempts to account for the variance of a dependent variable.

When controlling for organizational complexity (before computing correlations between the administrative ratios and organizational size), stepwise regression analysis is used to "fit" the ratio of interest to organizational complexity before fitting what is left of the administrative ratio to organizational size. In this manner all the variance in the administrative ratio linearly associated with organizational complexity is removed.

Using hypothesis I (if organizational complexity is controlled, then the correlation between the ratio of the administrative component to organizational size and the size of the containing organization will not differ significantly from zero) as a single example, the following activity occurs: a linear function of organizational size and organizational complexity that "best fits" the administrative ratio is computed. The function is linear and if it is a significant "best fit," then the deviations between the administrative ratio and the function for organizational size and organizational complexity, when squared and appropriately weighted, are below an acceptable level (e.g., 0.05, 0.01, etc.). Thus a

Hypothesis I If organizational complexity is controlled, then the correlation between the ratio of the administrative component to organizational size and the size of the containing organization will not differ significantly from zero.

TABLE VII

F RATIOS FOR MODELING THE ADMINISTRATIVE COMPONENT RATIOS TO SIZE OF ORGANIZATION WHILE CONTROLLING COMPLEXITY

Criterion Variable, Administrative Ratios Using Total Personnel	Controlled Variable, Total Complexity F Ratios	Step I Significance Level	Residual Comparison Variable, Total Personnel F Ratios	Step II Significance Level
I	0.106	N/S	1.109	N/S
II	0.038	N/S	0.653	N/S
III	0.645	N/S	0.322	N/S
IV	1.007	N/S	0.719	N/S
V	0.074	N/S	0.036	N/S

Hypothesis II If the ratio of the administrative component to organizational size is controlled, then the correlation between organizational size and organizational complexity will not differ significantly from zero.

TABLE VIII

F RATIOS FOR MODELING SIZE OF ORGANIZATION TO COMPLEXITY WHILE CONTROLLING ADMINISTRATIVE COMPONENT RATIO

Criterion Variable, Organizational Size	Controlled Variable, Ratio Using Total Personnel F Ratios		Step I Significance Level	Residual Comparison Variable, Total Complexity F Ratios	Step II Significance Level
Total Personnel	I	1.268	N/S	41.863	(0.01)
Total Personnel	II	0.259	N/S	40.665	(0.01)
Total Personnel	III	0.513	N/S	38.877	(0.01)
Total Personnel	IV	0.166	N/S	39.490	(0.01)
Total Personnel	V	0.048	N/S	38.858	(0.01)

significant correlation or regression equation is significant because it accounts for an acceptable amount of variance. When the regression equation is significant, the residuals between administrative ratios and the estimate of the administrative ratios are minimal.

After controlling for organizational complexity, the residuals are "fitted" to organizational size; if the fit is significant, the null hypothesis is rejected. If the fit is not significant, the hypothesis is accepted.

To determine if the "fit" is significant, steps in the regression analysis are observed. If the regression equation is not significant after the first step, but is significant after the second step, then the hypothesis can be rejected.

For example:

First Step

Second Step	Significant	Not Significant
Significant	Accept*	Reject
Not Significant	Accept	Accept

*The hypothesis would be rejected if the significance were remarkably greater after the second step.

Hypothesis III If organizational size is controlled, then the correlation between organizational complexity and the ratio of the administrative component to organizational size will not differ significantly from zero.

TABLE IX

F RATIOS FOR MODELING COMPLEXITY TO ADMINISTRATIVE COMPONENT RATIO WHILE CONTROLLING ORGANIZATIONAL SIZE

Criterion Variable, Total Complexity	Controlled Variable, Organizational Size: Total Personnel F Ratios	Step I Significance Level	Residual Comparison Variable, Ratios Using Total Personnel F Ratios I-V	Step II Significance Level
Total Complexity	79.566	(0.01)	40.213	(0.01)
Total Complexity	79.566	(0.01)	40.350	(0.01)
Total Complexity	79.566	(0.01)	39.059	(0.01)
Total Complexity	79.566	(0.01)	40.669	(0.01)
Total Complexity	79.566	(0.01)	38.894	(0.01)

When comparing administrative ratios and organizational size, the ratios first are computed using pupil size. The latter ratio, then, is compared with total personnel of the organization. Next, administrative ratios are computed using total personnel which is then compared with the pupil size of the organization. This is done to insure unbiased observation of the data, a requirement of regression analysis.

results of tests of hypotheses

Each hypothesis is discussed independently followed by a summary discussion of the relevant findings.

On the basis of results obtained using stepwise regression analysis of the data, hypothesis I was accepted. The regression analysis revealed that th size of the administrative component was not linearly related to organizational size. That is, if organizational size increases, a proportionate increase in the size of the administrative component is unlikely when complexity is controlled. Thus, the size of the administrative component is not directly related to organizational size. Furthermore, regardless of the definition used for the make-up of the administrative ratio, the findings remain the same.

An observation of the steps in the regression analysis was made to determine if the "fit" was significant. The analysis revealed that the F Ratios for step I in the equation were not significant. However, the F Ratios for step II were significant at the 0.01 confidence level. Based on this evidence, then, hypothesis II was rejected. The analysis of the data reveals that a significant linear relationship exists between size of organization and complexity when administrative ratio is controlled. Thus, when size of organization varies, there is a direct and commensurate variance in the level of organizational complexity. That is, large organizations (school systems) are more complex than are small ones. The finding holds for all five administrative ratios regardless of definitional differences.

An observation of the steps in the regression equation revealed that the F Ratios obtained for steps I and II were significant at the 0.01 confidence level. However, the fact that the F Ratios for step II were less or smaller than were those for step I causes the hypothesis to be accepted. In other words, most of the variance in the equation was accounted for in step I rather than in step II.

Acceptance of hypothesis III indicates that the data did not obtain a linear relationship between organizational complexity and the size of the administrative component when size of organization was controlled. Therefore, it appears that organizational complexity is not directly related to the size of the administrative component. Furthermore, definitional differences for the administrative ratio do not alter the finding.

summary discussion

The evidence obtained from the tests of the operational hypothesis suggests that neither organizational size nor organizational complexity is useful in predicting (modeling) the administrative ratio for Oregon school systems. In this regard, the study's central problem was to examine the relationship between the size of the administrative component-organizational size ratio and size of organization when organizational complexity is controlled. Even when organizational complexity is controlled, size of organization is not a good predictor of the size of the administrative component. Furthermore, there is an apparent absence of a linear relationship between the administrative component ratio and organizational complexity. Thus, when organizational size is controlled, complexity is no better a predictor of the size of the administrative component than was size of organization with complexity being controlled.

However, there may be a non-linear relationship between size of the administrative component ratio and size of organization. Determination of the exact form of any non-linear relationship that may exist was beyond the scope of this study. A significant linear relationship exists between size of organization and organizational complexity. The relationship suggests that as the organization grows a direct increase occurs in the complexity of the organization.

V

SUMMARY AND CONCLUSIONS

The central problem for study was the examination of the ratio relationship between organizational size and the administrative component when organizational complexity was controlled.

Three guiding questions were developed that resulted in the formulation of three hypotheses. These hypotheses were constructed to determine the effect of the organizational complexity variable on the size relationship between the other two variables.

To investigate the problem, a representative sample of Oregon school systems was selected. Forty-five public school systems of varying size (pupil ADM) and type (elementary, high school, and unified districts) were selected for the final sample. Data were collected during visits to intermediate education units and the school systems of the sample. Five definitions of administrative component, two of system size, and one of organizational complexity were used. The definitions for the variables of administrative component and system size were converted into corresponding definitions of administrative ratio. These administrative ratios later were utilized as an index of the size of the administrative component in the stepwise multiple regression analysis of the data.

The complexity measure consisted of four parts: division of labor--general, division of labor--specific, hierarchical differentiation, and spatial dispersion, translated into a single representative score. Raw data obtained from the parts of the complexity measure were converted to standard scores (T-scores). Then the data were added to obtain the composite complexity score needed for each sample school system. Pearson product-moment correlations were obtained for the four independent parts of the complexity measure to assess their interrelationship and to determine their relationship with the total score; it was found to be an accurate representation of its four parts.

The sample systems were grouped into categories of small, medium, and large on the basis of their pupil enrollment (ADM) and total number of employees. And for the purpose of comparison with other school-system studies, the sample systems were grouped according to their type: elementary, high school, and unified. Further breakdown was accomplished using only one measure of system size, total number of employees. This was warranted because of the high correlation--significant at the 0.01 confidence level--between the two measures of system size. In addition, this measure of size is the more popular of the two because it is applicable to organizational types other than school systems.

The three hypotheses of the study were stated in statistical form for testing. Essentially, this was done so that the relationship among the three major variables--administrative ratio, organizational size, and complexity--could be examined to allow any two variables to be viewed while controlling for the effect of the third. In testing the hypotheses, then, stepwise regression analysis was used to control these key variables and the computations (or linear regression equations) were attempts to account for the

variance of a dependent variable.

To compare the findings of this study with those of other school-system studies, only two of the three major variables--size of organization and the administrative component size--were dealt with. One measure of the administrative component was used. This was an administrative ratio consisting of the number of administrative personnel to the size of the organization.

Only one measure of organizational size, total number of employees, was used in this comparison. Since other school-system studies used either mean percentages or mean administrative ratios to express the administrative component, it seemed appropriate, for comparative purposes, to compute administrative component mean-percentages from the data. This was a simple computation produced by multiplying the administrative ratio by one hundred to obtain the mean percentage and done for each size grouping: small, medium, and large.

Analysis of variance was used as the statistical test for differences among means for the various size groupings. In addition, where direct comparisons were made with the findings of other school-system studies, the same tests of significance were applied to all the data.

findings of the study

This summary of findings looks first at the results of the test of each hypothesis and follows with an observation regarding all three.

Hypothesis I

> If organizational complexity is controlled, then the correlation between the ratio of the administrative component to organizational size and the size of the containing organization will not differ significantly from zero.

On the basis of results obtained using stepwise regression analysis of the data, hypothesis I was accepted. The regression analysis revealed that the size of the administrative component is not linearly related to organizational size. This suggests that if organizational size increases, a proportionate increase in the size of the administrative component is unlikely when organizational complexity is controlled. Furthermore, regardless of the definition used for the make-up of the administrative ratio, the findings remain the same.

Hypothesis II

> If the ratio of the administrative component to organizational size is controlled, then the correlation between organizational size and organizational complexity will not differ significantly from zero.

An observation of the steps in the regression analysis was made to determine if the "fit" was significant. The analysis revealed that the F ratios for step I in the equation were not significant. However, the F ratios for step II were significant at the 0.01 confidence level. Based on this evidence, then, hypothesis II was rejected. The analysis of the data revealed that a significant linear relationship exists between size of organization and organizational complexity when administrative ratio is controlled. Thus, when size of organization varies, there is a direct and commensurate variance in the level of organizational complexity. That is, large organizations (school systems) are more complex than are small ones. The finding holds for all five administrative ratios regardless of definitional differences.

Hypothesis III

> If organizational size is controlled, then the correlation between organizational complexity and the ratio of the administrative component to organizational size will not differ significantly from zero.

An observation of the steps in the regression equation revealed that the F ratios obtained for steps I and II were significant at the 0.01 confidence level. However, the fact that the F ratios for step II were less significant than those for step I caused the hypothesis to be accepted. In other words, most of the variance in the equation was accounted for in step I rather

than in step II.

Acceptance of hypothesis III indicates that the data did not obtain a linear relationship between organizational complexity and the size of the administrative component when size of organization was controlled. Therefore, it appears that organizational complexity is not directly related to the size of the administrative component. Furthermore, definitional differences for the administrative ratio did not alter the findings.

The evidence obtained from the tests of the three operational hypotheses suggests that neither organizational size nor organizational complexity is a useful variable in predicting (modeling) the administrative ratio for Oregon school systems.

comparison of findings with other school-system studies

Another purpose of the study was to add information to the literature concerning the nature of the relationship between the two organizational variables of school-system size and size of the administrative component.

The research findings from other school-system studies utilizing the two variables can be summarized in the following manner: as the size of the school system increases, there is a proportionate increase in the size of the administrative component. Or, as the school-system size increases, there is a decrease in the size of the administrative component.

The only school-system study supporting the first position was done by Terrien and Mills in 1955. Three later studies--Gill and Friesen (1968), Vithayathil (1969), and Blowers (1969)--using school systems of Western Canada as the sample found the latter position to be true.

Although all four studies used a common definition of system size--total number of employees--each differed in how it presented the data for the size of the administrative component. Terrien and Mills used the mean percentage of the number of employees in the administrative component and separated their data by type of school system, i.e., elementary, high school, and unified systems. The other researchers used an administrative ratio consisting of the number of employees in the component in relation to size of organization. Multiplication of the administrative ratio by 100 provided a comparative equivalency (mean percentages) for the size of the administrative component data. However, direct comparisons could be made only for a composite of system type since the data were not available in the form used by Terrien and Mills.

The data used in this study were computed and displayed, then, in two forms. One method duplicated Terrien and Mills' work while the other was in a form used by the other studies.

The results obtained from the analysis of the data for the Oregon study suggests that when system type is disregarded, all five definitions support the notion that as size of organization increases, the size of the administrative component decreases when complexity is controlled. These findings are tenuous, however, since an acceptable level of statistical significance generally was not attained.

Another finding from this study indicates that the way the administrative component definition is constructed, i.e., how broadly is the make-up of the personnel in the component, makes a difference in the results obtained.

When the data for this study were examined by type of system, the elementary system supports the proposition that as size of system increases there is a proportionate increase in the size of the administrative component. The opposite finding occurred for the other two types, high schools and unified systems.

So when comparisons were made with other school-system studies, the research findings of Terrien and Mills received only partial support. The bulk of the evidence resulting from the findings of Gill and Friesen,

Vithayathil, and by inference those of Blowers, was in harmony with the findings of this study.

What is suggested, then, is that the size of the organization alone does not account for the size of its administrative component.

conclusions

Original speculation that unidentified factors like organizational complexity might account for disparate research findings regarding the relationship between size of the administrative component and organizational size remains. Although complexity and size of organization were found to be significantly related variables in this study, there is no evidence to support the notion that the administrative ratio is linearly related to either of the two organizational variables.

What, then, might explain how the size of the administrative component relates to the size of the organization? Four areas of speculation are considered: irrationality in organization, "administrative style," wealth of the system, and Blau's "Formal Theory of Differentiation in Organizations."

The first, "irrationality in organization," suggests the possibility that the make-up of the administrative component is dependent entirely on man. That is, the whims of individuals in leadership positions often influence the decisions relative to the amount of administrative overhead. The possibility exists that the size of the administrative component is not logically dependent on the explicit needs of the organization. For example, this conception frequently is referred to as unconstrained administration in school systems. One of the attributes of this concept, based on the premise of only enough administration to minimally meet the purposes of an organization, has been expressed by Ladd:

> "Another virtue of unconstrained administration, if indeed it is one, is that it allows us to keep our schools running with relatively few administrators. A single administrator in a school comprising a thousand people is not a rarity. Similarly, if you put the decision-making for the whole system largely into the hands of a superintendent, he can keep quite a number of schools going with the aid of only a tiny office staff."

"Administrative style" might account for the number of administrators. According to Stogdill, et al.,

> There also is evidence to suggest that executives carry their own personal leadership styles from one organization to another, and that this predilection for a particular leadership style probably influences the leader's perception of the organization's problem(s).

It follows then, that the leader's perception of the problem(s) and his leadership style might influence the number and kind of administrators that his system has.

The relative "wealth" of a school system, while not necessarily causal, might permit greater leeway in the determination of both the type and number of administrators.

Another explanation regarding the relationship between size of administrative component and organizational size is submitted by Blau. In presenting his "Formal Theory of Differentiation in Organizations," Blau suggested:

> "The expanding size of organizations gives rise to increasing subdivision of responsibilities, facilitates supervision and widens the span of control of supervisors, and simultaneously creates structural differentiation and problems of coordination that require supervisory attention. Large size, therefore, has opposite effects on the administrative component, reducing it because of an economy of scale in supervision, and raising it indirectly because of the differentiation in large organizations. The administrative costs of differentiation have feedback effects, which reduce the savings in administrative overhead large size effects, on the one hand, and stem the influence of size on differentiation, on the other."

In contrast, the analysis of data from this study shows a linear relationship between organizational size and complexity that suggests that the two organizational variables vary together. Knowing that such a relationship exists from this cross-sectional study of school systems still does not explain whether growth in the size of the administrative component can be attributed to an increase in organizational size, or an increase in complexity, or some combination of the interaction of the two.

Certainly, Blau's theory seems worthy of continued empirical investigation. Such attention may account for the size of the component in terms of some non-linear and possibly logarithmic function of both organizational size and differentiation (organizational complexity).

However, the determination of the exact form of the relationship among the three variables of administrative component size, complexity, and size of organization still is unexplained. Thus it seems logical that the next step in the accumulation of empirical knowledge, at least about the administrative overhead in organizations like school systems, would concern this growth relationship.

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